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Title: URBAN 2000 Field Experiment: LANL Wind Sensors

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The URBAN2000 Field Experiment - LANL Wind Sensors

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Due to the threat of terrorist attacks in US cities, the DOE s Chemical and Biological National Security Program (CBNP) is leading an effort to develop numerical models to predict the transport and dispersion of CB agents in cities. The movement of air contaminants through a city, however, is highly complex. The winds high above a city may be very steady, but down amongst the buildings the flow may seem almost chaotic. You have probably seen a few pieces of paper get lifted off the sidewalk, swirl around at head-height, and then suddenly get lofted 15 to 20 feet into the air and blown down the street. Buildings obstruct flow and cause swirling eddies and updrafts, resulting in complex air flow patterns.

In order to test the efficacy of the program s urban dispersion models in these complicated flow regimes, experimentation has been a key component of the CBNP. As part of the effort to collect data for model validation, Los Alamos National Laboratory partnered with several other national laboratories, universities, and research agencies in a month-long measurement campaign in Salt Lake City in October 2000 called URBAN2000. In terms of manpower and equipment, this was on of the largest urban field experiments held within the last 30 years and was highlighted by six night-long intensive operations periods in which additional meteorological equipment was deployed and tracer gases were released and tracked across the city.

The experiment was unique in that it covered the building scale, the neighborhood scale, and the city scale (Shin et al., 2000). URBAN2000 benefited immensely from another DOE-sponsored field experiment called VTMX (Doran et al., 2000), which was conducted simultaneously across the entire Salt Lake Basin, therefore providing regional

Figure 1. Meteorological station for measuring temperature and winds located on the10th floor of a building in downtown Salt Lake City.

scale coverage and boundary conditions for the urban experimental domain. Researchers from LANL deployed six weather stations for the entire month of October, each comprising a 2-D ultrasonic anemometer and two temperature-sensing thermistors. Three stations were located on high, relatively unobstructed rooftops (see Figure 1), two were on lower rooftops in locations influenced by a 10-story building, and one was mounted on a light pole in a parking lot in the middle of a complex of buildings.

Figure 2 shows the winds measured in downtown Salt Lake City in the early morning hours of October 26. The black, red, and white vectors depict the wind on the high rooftops, the yellow and orange vectors are on the low rooftops influenced by the 10-story building, and the green vector is from the unit on the parking lot light pole. The tracer releases were performed close to the location of

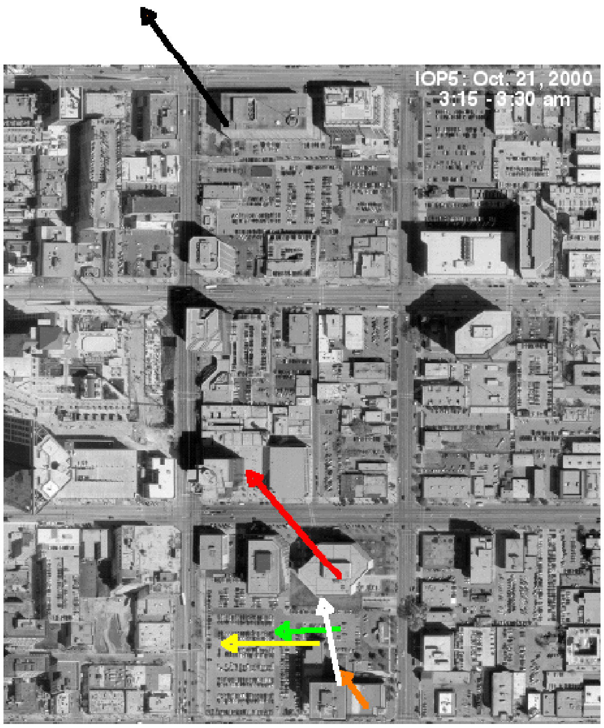

Figure 2. Early morning wind measurements show southeasterly winds aloft and channeling closer to the surface. Vectors represent a 15-minute average.

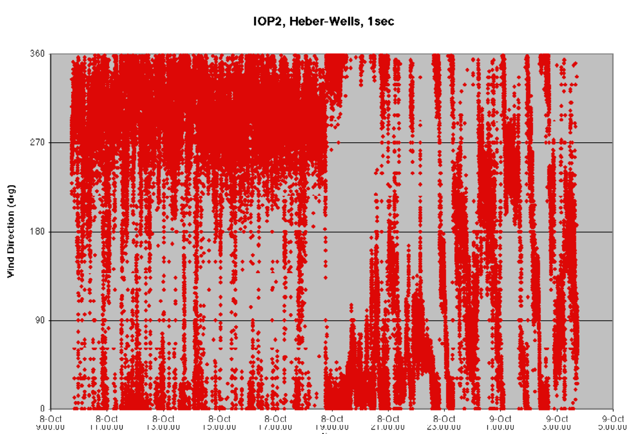

Figure 3. Wind direction at 1 s frequency showing an unusual periodicity during the nighttime hours.

the light pole, a few tens of meters to the northeast. While the movement of the tracer is not depicted, it is clear that it would move in a complex pattern that could not be simply represented by the winds measured at the rooftops, nor for that matter, by a single measurement made some 15-20 km away at the airport. The latter option is often, unfortunately, the only measurement available and is applied in quite simplistic models for urban dispersion in cities all around the US.

Figure 3 is a plot of wind direction taken at 1 second intervals during the day of Oct. 6 and into the next morning. After 9 pm, a very distinct periodicity in the wind direction may be observed. This periodicity is seen on other days as well and in the wind speed and temperature records. The cause of this periodicity has not yet been determined, but it is almost certainly linked to a basin-wide phenomena. This is a dramatic reminder that regional scale meteorology will drive the inner-city wind patterns, but in itself is not sufficient to describe all the complexities of flow in an urban area.

URBAN2000 was a major success for the Department of Energy, Los Alamos National Laboratory, and all the other participants. There is now a wealth of new data available to plumb for insights into urban flow and transport phenomena and the modeling community has data to challenge their skills in urban simulation. The URBAN2000 field experiment was led by researchers at Lawrence Livermore, Los Alamos, and Pacific Northwest National Laboratories.

References:

Doran, C., J. Fast, and J. Horel, 2001: The VTMX 2000 Campaign , in preparation.

Shinn, J.H., K.J. Allwine, and G.E. Streit, 2000: "The DOE URBAN field program for 2000-2004", 3rd AMS Urban Env. Symp., Davis, CA, LA-UR-01-1467.

Streit, G., E. Pardyjak, M. Brown, D. DeCroix, T. McPherson, W. Smith, 2001: "The Salt Lake City DOE CBNP URBAN Field Experiment of Fall 2000: Urban Wind and Temperature Measurements Data Report", LA-UR-01-950.

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